(12) LEVEL II

FG

DASIAC SR 174

FALLOUT HAZARD PREDICTION INCONSISTENCIES

General Electric Company—TEMPO
DASIAC
816 State Street
Santa Barbara, California 93102

1 October 1979

Final Report for Period 1 October 1978 - 1 October 1979

CONTRACT No. DNA 001-79-C-0081

Approved for public release; distribution unlimited.

THIS WORK SPONSORED BY THE DEFENSE NUCLEAR AGENCY
UNDER RDT&E RMSS CODE B337079464 P99QAXDC00809 H2590D.

Prepared for:
Director
DEFENSE NUCLEAR AGENCY
Washington, D.C. 20305

Table 5-2. Characteristics of test shots in parameter comparisons.

Shot	Yield (KT)	SDOB[a] (m)
JANGLE-S	1.2	-1.0
JOHNIE BOY	0.5	-0.74
JANGLE-U	1.2	4.9
ESS	1.3	19
SCHOONER	31	34
CABRIOLET	2.3	39
DANNY BOY	0.42	45

[a]Scaled depth of burial at detonation.

In the evaluation of prediction capability, each model had three isodose contours to predict for each of seven shots for a maximum score of 21. The accumulated numbers of predicted areas, within the enclosed isodose criteria of $\pm$30 percent, are shown in Table 5-10. The most capable predictors for these two surface and five buried shots were PROFET, EM-1, and KDFOC. PROFET has an 83 percent success rate where it produced isodose contours, and refused to predict contours for all of the underground shots. However, its overall success rate was 24 percent. SEER failed the criteria in all predictions, and had the highest refusal rate of 17 out of 21. In general, the models made a poor showing at predicting the contaminated areas in the yield range where they are most adept at predicting, the low KT range. Among the shots, JANGLE-U isodose enclosed areas were modeled best at 7 successes in 15 predictions and JOHNIE BOY was next at 6 successes in 21 predictions. The models were least able to predict the areas enclosed by isodose contours on ESS and CABRIOLET.

Table 5-3. Comparative pattern statistics from JANGLE-S and fallout models.*

Statistics	Gamma Isodose Contour (R/hr)			
	35	100	300	500
JANGLE-S				
Hotline Length (m)	5066	3737	1498	693
Hotline Azimuth (deg)	6	1	346	342
Area (km^2)	3.17	1.44	0.38	0.12
AUGER				
Hotline Length (m)	7320	4834	3496	2829
Hotline Azimuth (deg)	8	18	18	18
Area (km^2)	7.04	2.59	1.33	0.85
DELFIC				
Hotline Length (m)	14843	5750	1420	1250
Hotline Azimuth (deg)	1	0	0	359
Area (km^2)	12.35	2.61	0.61	0.23
EM-1				
Hotline Length (m)	16000	8100	3700	2600
Hotline Azimuth (deg)	8	8	8	8
Area (km^2)	6.20	1.30	0.23	0.10
KDFOC				
Hotline Length (m)	6523	4343	3009	2343
Hotline Azimuth (deg)	8	18	18	19
Area (km^2)	6.66	3.04	1.41	0.87
LASEER				
Hotline Length (m)	12881	6320	1501	500
Hotline Azimuth (deg)	8	8	358	357
Area (km^2)	24.51	4.70	0.40	0.22
PROFET				
Hotline Length (m)	8274	3517	293	287
Hotline Azimuth (deg)	4	354	270	270
Area (km^2)	3.60	0.56	0.14	0.14
SEER				
Hotline Length (m)	11426	5587		
Hotline Azimuth (deg)	10	10		
Area (km^2)	18.34	4.02		

* Adapted from Reference 5-5

Table 5-4. Comparative pattern statistics from JOHNIE BOY and fallout models*

Statistics	Gamma Isodose Contour (R/hr)		
	10	50	100
JOHNIE BOY			
Hotline Length (m)	10623	4102	2733
Hotline Azimuth (deg)	345	343	345
Area (km^2)	10.68	1.27	0.54
AUGER			
Hotline Length (m)	9431	3295	2035
Hotline Azimuth (deg)	347	352	348
Area (km^2)	13.06	3.33	0.90
DELFIC			
Hotline Length (m)	9673	5399	3319
Hotline Azimuth (deg)	349	346	348
Area (km^2)	7.66	2.24	1.10
EM-1			
Hotline Length (m)	10000	6500	4000
Hotline Azimuth (deg)	359	359	359
Area (km^2)	5.80	1.90	0.58
KDFOC			
Hotline Length (m)	15300	3003	1357
Hotline Azimuth (deg)	355	350	23
Area (km^2)	26.86	3.32	1.23
LASEER			
Hotline Length (m)	13042	5717	3105
Hotline Azimuth (deg)	345	344	345
Area (km^2)	27.85	5.77	2.18
PROFET			
Hotline Length (m)	10495	4857	3087
Hotline Azimuth (deg)	348	348	346
Area (km^2)	7.58	1.63	0.55
SEER			
Hotline Length (m)	13180	364	3622
Hotline Azimuth (deg)	348	346	345
Area (km^2)	25.55	6.44	3.09

* Adapted from Reference 5-5

Table 5-5. Comparative pattern statistics from JANGLE-U and fallout models*

Statistics	Gamma Isodose Contour (R/hr)		
	100	200	500
JANGLE-U			
Hotline Length (m)	5231	2985	1380
Hotline Azimuth (deg)	25	18	348
Area (km^2)	5.86	2.24	0.58
AUCER			
Hotline Length (m)	9457	5322	1543
Hotline Azimuth (deg)	36	24	48
Area (km^2)	18.57	4.71	0.98
DELFIC			
Hotline Length (m)	9727	6533	2676
Hotline Azimuth (deg)	29	26	21
Area (km^2)	6.60	3.30	0.92
EM-1			
Hotline Length (m)	9100	5300	2500
Hotline Azimuth (deg)	36	36	36
Area (km^2)	2.50	0.55	0.099
KDFOC			
Hotline Length (m)	3694	2280	1499
Hotline Azimuth (deg)	25	27	50
Area (km^2)	4.52	2.42	0.70
LASEER			
Hotline Length (m)	4140	2306	1173
Hotline Azimuth (deg)	46	23	20
Area (km^2)	6.74	2.45	0.66

* Adapted from Reference 5-5

Table 5-6. Comparative pattern statistics from ESS and fallout models*

Statistics	Gamma Isodose Contour (R/hr)			
	10	50	100	500
ESS				
Hotline Length (m)	7275	4186	2238	1192
Hotline Azimuth (deg)	134	136	127	124
Area (km^2)	14.32	6.26	3.55	1.37
AUGER				
Hotline Length (m)	34570	13379	5129	1615
Hotline Azimuth (deg)	154	142	133	87
Area (km^2)	203.9	36.08	5.66	2.05
EM-1				
Hotline Length (m)	26000-34000	13000-16000	8500-11000	2400-3100
Hotline Azimuth (deg)	149	149	149	149
Area (km^2)	35.0-61.0	4.9-8.1	1.7-2.8	0.12-0.20
KDFOC				
Hotline Length (m)	33265	13458	3300	1509
Hotline Azimuth (deg)	152	140	128	81
Area (km^2)	198.7	30.66	4.79	2.05
LASEER				
Hotline Length (m)	19307	8489	6100	964
Hotline Azimuth (deg)	136	140	138	142
Area (km^2)	69.92	17.15	8.71	0.39

* Adapted from Reference 5-5

Table 5-7. Comparative pattern statistics from SCHOONER and fallout models.*

Statistics	Gamma Isodose Contour (R/hr)			
	1	10	20	100
SCHOONER				
Hotline Length (m)	27517	9319	8232	830
Hotline Azimuth (deg)	50	1	1	142
Area (km^2)	209.7	36.75	18.79	1.67
AUGER				
Hotline Length (m)	15155	2820	1990	919
Hotline Azimuth (deg)	23	56	40	37
Area (km^2)	121.3	11.75	6.73	0.44
EM-1				
Hotline Length (m)	6300-24000	-	-	-
Hotline Azimuth (deg)	67	67	67	67
Area (km^2)	0.96-14.0	-	-	-
KDFOC				
Hotline Length (m)	31178	3438	3151	1879
Hotline Azimuth (deg)	51	34	38	66
Area (km^2)	230.9	12.75	7.23	1.422
LASEER				
Hotline Length (m)	21795	3979		
Hotline Azimuth (deg)	60	56		
Area (km^2)	85.93	3.12		

*Adapted from Reference 5-5

Table 5-8. Comparative pattern statistics from CABRIOLET and fallout models*

Statistics	Gamma Isodose Contour (R/hr)		
	1	10	100
CABRIOLET			
Hotline Length (m)	2674	634	337
Hotline Azimuth (deg)	340	264	177
Area (km^2)	3.18	0.73	0.17
AUGER			
Hotline Length (m)	21407	3659	1959
Hotline Azimuth (deg)	43	351	15
Area (km^2)	193.4	4.55	2.04
EM-1			
Hotline Length (m)	4700-18000	1400-5600	240-960
Hotline Azimuth	47	47	47
Area (km^2)	0.98-14.0	0.048-0.72	0.0066-0.10
KDFOC			
Hotline Length (m)	21932	5410	2030
Hotline Azimuth (deg)	26	2	6
Area (km^2)	175.0	9.24	2.07
LASEER			
Hotline Length (m)	17387	5066	786
Hotline Azimuth (deg)	38	38	17
Area (km^2)	86.75	7.79	0.43

* Adapted from Reference 5-5

Table 5-9. Comparative pattern statistics from DANNY BOY and fallout models.*

Statistics	Gamma Isodose Contour (R/hr)			
	5	10	50	100
DANNY BOY				
Hotline Length (m)	1778	1464	638	451
Hotline Azimuth (deg)	355	357	5	11
Area (km^2)	1.27	0.80	0.33	0.24
AUGER				
Hotline Length (m)	10368	7400	2752	1227
Hotline Azimuth (deg)	3.1	357	353	328
Area (km^2)	21.70	12.77	2.53	1.13
EM-1				
Hotline Length (m)	3400-6500	270-5000	130-2400	82-1600
Hotline Azimuth (deg)	11	11	11	11
Area (km^2)	0.073-2.7	0.0034-1.2	0.00036-0.13	0.00011-0.043
KDFOC				
Hotline Length (m)	16942	13753	6349	2157
Hotline Azimuth (deg)	357	2	3	13
Area (km^2)	36.68	26.25	6.60	2.38
LASEER				
Hotline Length (m)	15856	11916	5519	4013
Hotline Azimuth (deg)	353	356	355	355
Area (km^2)	27.80	16.23	4.35	2.45

* Adapted from Reference 5-5

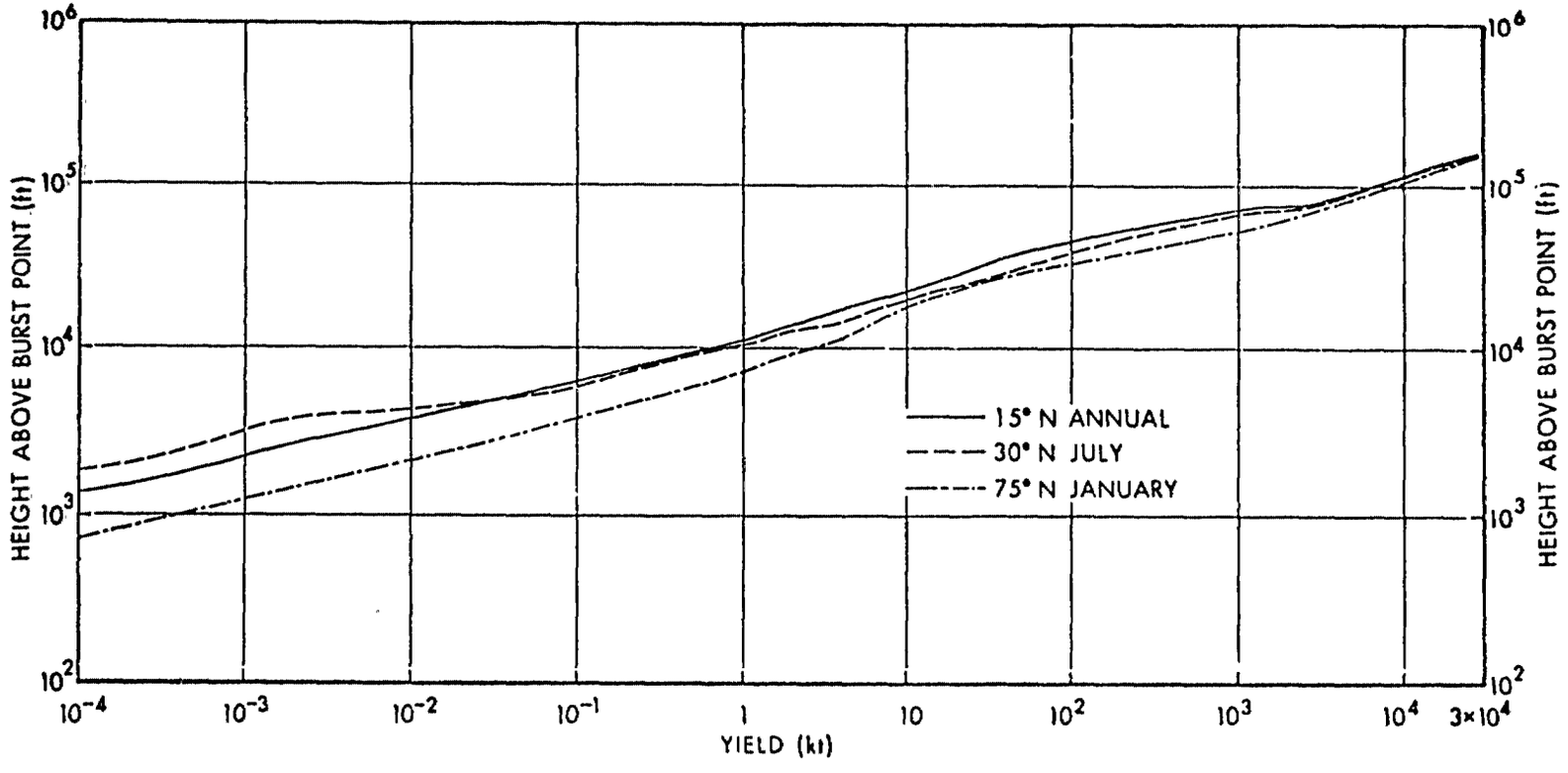

Figure 6-2. Cloud top heights computed by the DELFIC code, using three standard atmospheres (Reference 6-6).

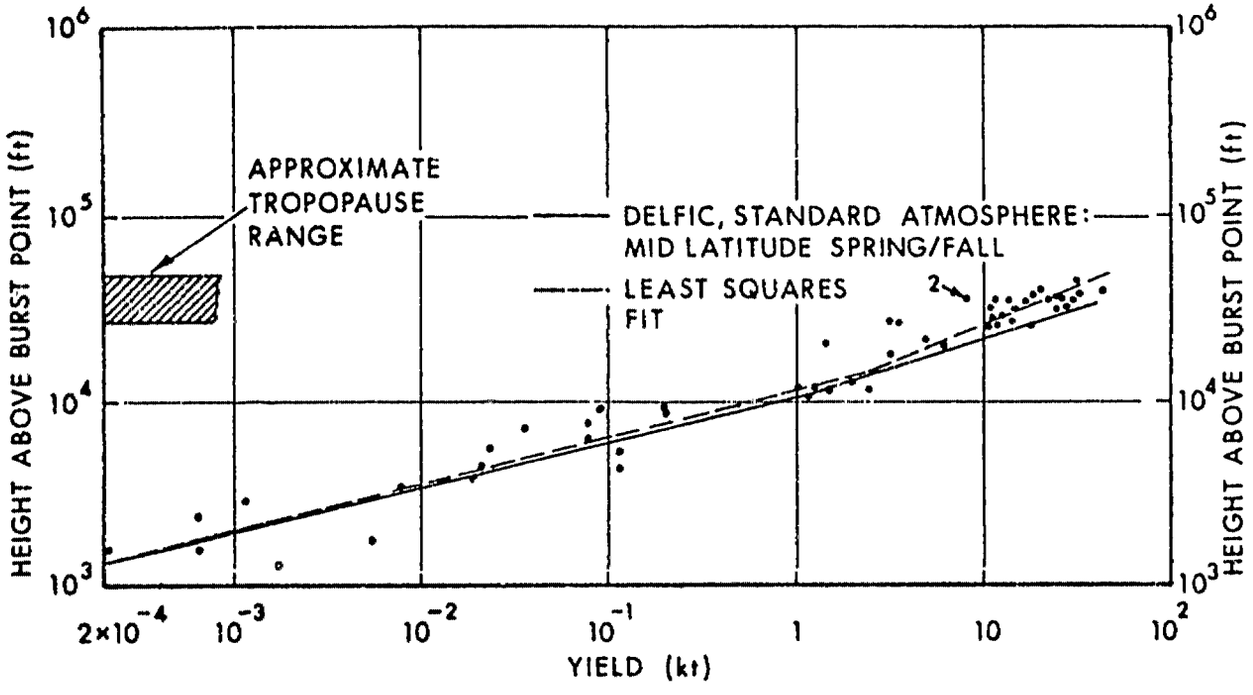

Figure 6-3. Cloud top heights versus yields, Nevada bursts, Spring and Fall (observed values and least-squares fit, and values computed by the DELFIC code using the standard atmosphere - midlatitude, Spring/Fall) (Reference 6-6).

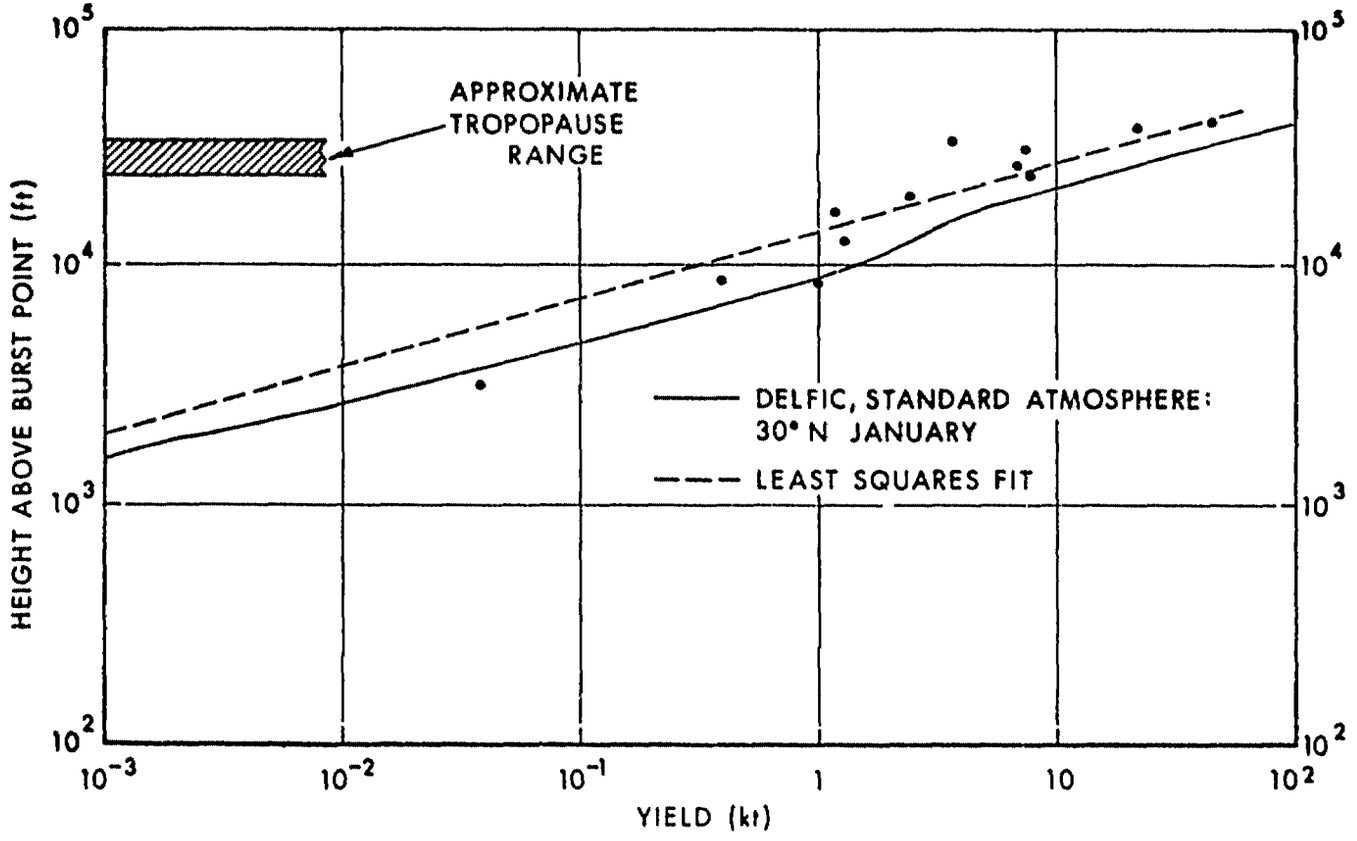

Figure 6-4. Cloud top heights versus yields, Nevada Winter season (observed values and least-squares fit, and values computed by the DELFIC code, using the standard atmosphere, 30 degrees North, January) (Reference 6-6).

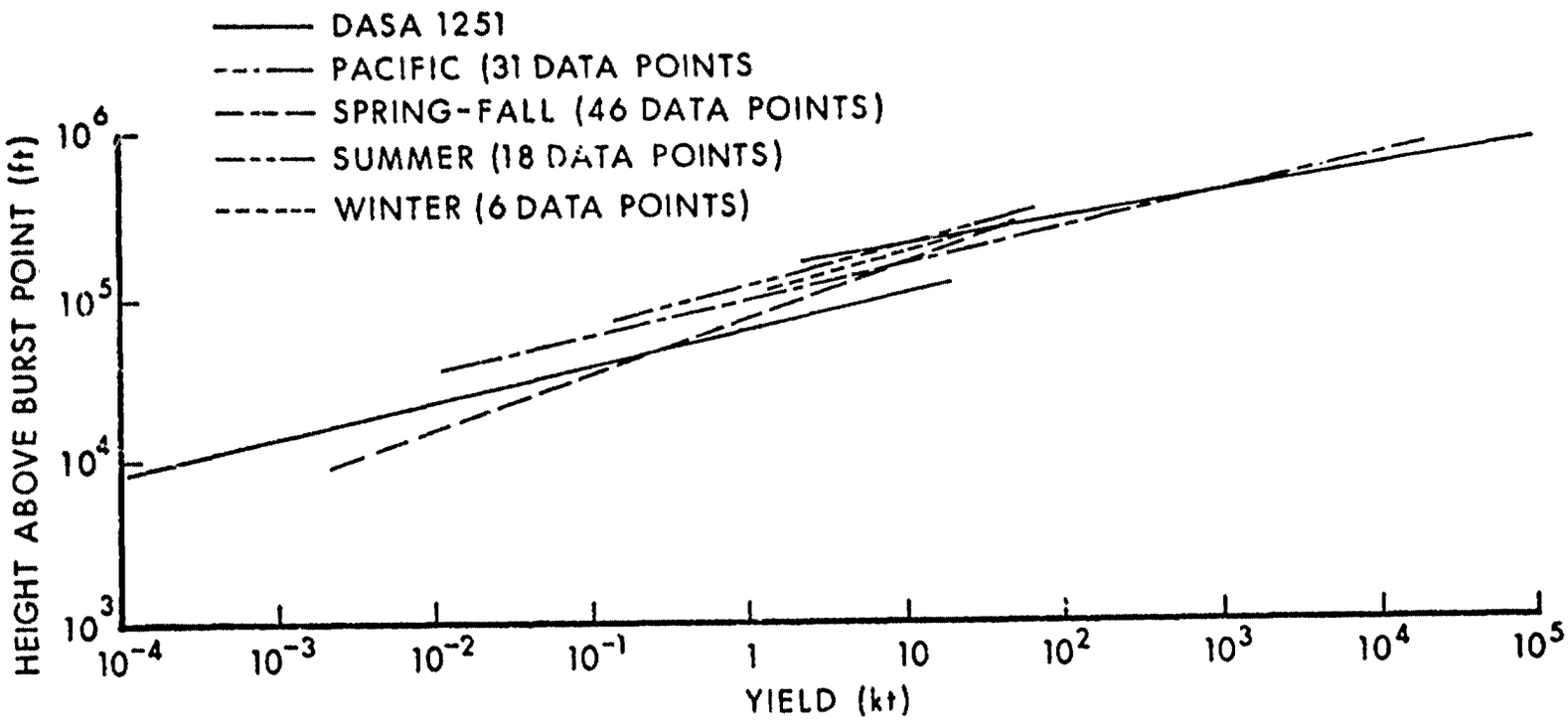

Figure 6-5. Summary of graphs based on observed cloud top heights versus yields (Reference 6-6).

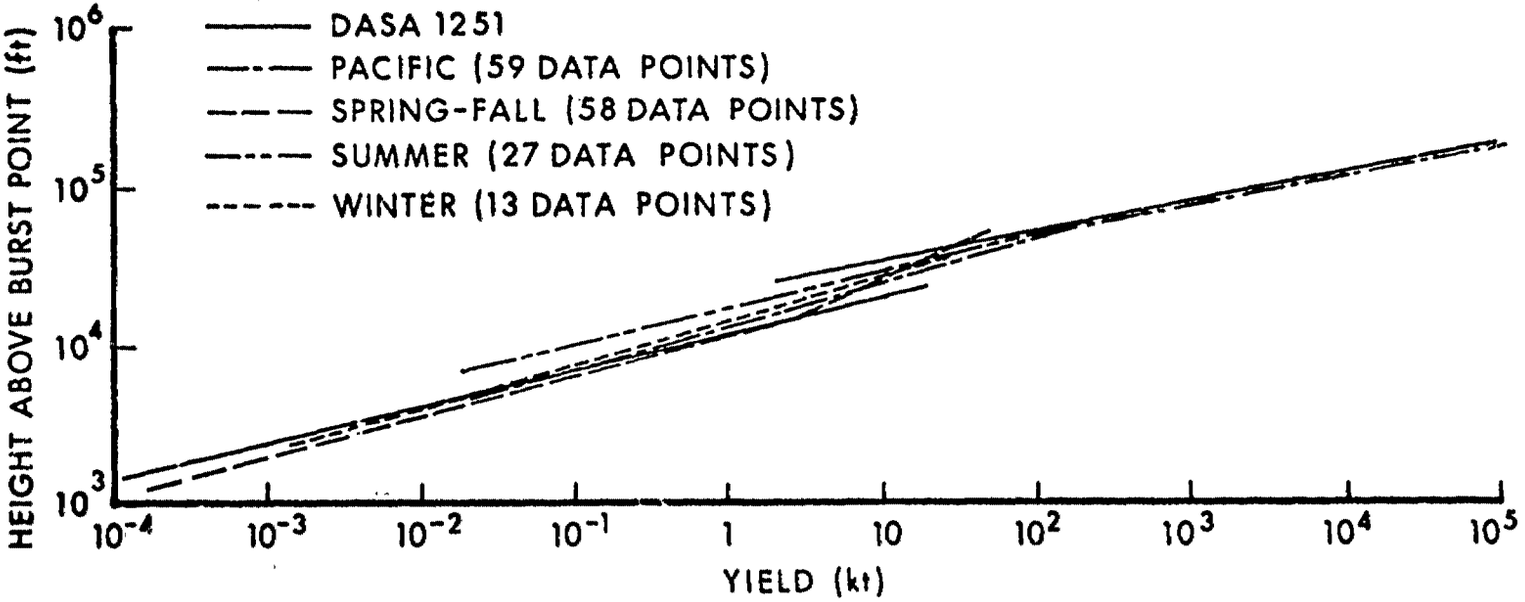

Figure 6-6. Summary of graphs based on observed cloud bottom heights versus yields (Reference 6-6).

Table 6-4. Normalization factors.

Model	NF (R/Hr per KT per Sq. Mile)
LRL-h	2700
Dropsy	2585
NREC	2500
WSEG	2400
RAND	1200
DIA	1100 (implicit)[a]
NRDL-D	1093
USWB	1025
Ford-T	900
TOR	870
Sig C	689
RADFO	not treated in this model
Army	not treated in this model
AN/GMQ-18	no information available

[a]Equivalent value[1]

Table 6-5. Surface burst K-factors.

Model	Nominal K-Factor $\left(\frac{r - mi^2}{hr - kT}\right)$	Fraction of Activity on Particles Larger than 50 μm	Correction[a] or Amplification[b] Factors	Effective K-Factor $\left(\frac{r - mi^2}{hr - kT}\right)$
DELFIC[c]	~2400	0.56	0.5	672
PROFET	~2700	0.47	0.5	634
SEER	2346	0.74	>2	>3472
KDFOC	2500	0.29	0.5	362
AUGER	2500	0.29	0.5	362
LASEER	2000	0.74	>1.4	>2072
WSEG-10	2500	0.79	-	2000

[a] DELFIC and PROFET apply a combined ground roughness and instrument response correction factor of 0.5. LASEER applies a ground roughness factor of 0.7. KDFOC and AUGER assume that only half the activity is in the cloud for a surface burst.

[b] SEER and LASEER arbitrarily multiply activity by a factor with a minimum value of 1.75, but which usually has a value of 2 or greater. (Though the users instructions do not call for it, we have applied a combined ground roughness-instrument response correction factor of 0.5.)

[c] The DELFIC nominal K-factor is a typical value computed from output of the DELFIC particle activity module. DELFIC does not use a preset or constant K-factor.

Table 6-6. Comparative parameters from KDFOC, AUGER and LASEER in fallout prediction.

Shot Modelled[a]	Model Name	Parameters Predicted by Fallout Models[b]					
		Base Surge Height (m)	Base Surge Radius (m)	Main Cloud Height (m)	Main Cloud Radius (m)	Fraction of Nominal K-Factor in the Clouds	Proportion of Activity in Main Cloud
ESS	KDFOC	1260	2520	2540	660	0.48	78%
	AUGER	1260	2520	3110	980	0.72	74%
	LASEER	1260	1900	2480	590	1.05	80%
SCHOONER	KDFOC	1400	6650	4200	1120	0.45	73%
	AUGER	1400	6650	5530	3780	0.46	49%
	LASEER	~1400	~6650	4180	1190	0.92	80%
DANNY BOY	KDFOC	390	1200	960	260	0.36	59%
	AUGER	390	1200	1800	600	0.29	32$
	LASEER	490	1180	990	220	0.82	60%

[a] Nuclear characteristics are shown in Table 5-2.

[b] From Reference 6-5.